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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
DRODGE, JOSEPH W	
ART UNIT	**PAPER NUMBER**
1723	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/24/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/695,374	CHACE ET AL.	
	Examiner	Art Unit	
	Joseph W. Drodge	1723	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 March 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-7 and 9-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-7 and 9-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1,3-7, 9-13 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shaffer et al Document US2002/0052125 in view of Van Cleemput et al patent 6,576,345 and McCullough et al patent 5,908,510.

Shaffer et al disclose a process for forming an etched, coated semiconductor device followed by removing impurities that comprises: disposing a low dielectric constant curable organic polymeric film, generally as a multi-layer film (Abstract, paragraphs 25-27 and 63 in particular) on an electrically conductive surface of a semiconductor substrate device (paragraphs 3-4,81, etc.), curing the film layers (paragraphs 65-68) and contacting the film layer(s) with heat in a baking step, to remove impurities from the film and device (paragraph 66). The film may be of polyarylene resin (paragraphs 25-27), {as in amended claim 1} or of polysilsequioxane (paragraphs 32 and 63), {as in amended claim 18 and claims dependent therefrom}.

The claims all differ in requiring the semiconductor device and applied film to be contacted with supercritical carbon dioxide effective to remove residual solvents, unreacted monomers and byproducts of curing. ***McCullough et al teach to remove residue from surfaces, especially top surfaces of (column 1, lines 18-19 and column 2, lines 50-54)***, semiconductor devices that may include etched and patterned composites having both silicon and polymeric layers (column 5, lines 38-56) by contact with supercritical carbon dioxide and optionally additives (column 5, lines 1-29), the contacting generally being at a significantly elevated heating temperature that may be in a range and of a duration to effect curing of the substrate and film (column 6, lines 1-14 of McCullough and see Shaffer at Paragraph 65). ***The semiconductor devices cleaned by supercritical carbon dioxide may include patterned film structures comprised of low dielectric polymer such as polyimide (column 5, lines 43-55) , such surfaces suggested as being "pre-processed" (column 2, lines 50-54).***

Shaffer mentions in paragraph 23 that polyimides may be used as a low dielectric filming polymer. Shaffer also describes in paragraphs 94-103 that the low dielectric polymeric material which is deposited onto a substrate constitutes a patterned organic film.

Van Cleempt et al teach to heat and react monomers of a low dielectric, thin film polymeric film and apply the film to a semiconductor substrate device followed by contacting the film and substrate with supercritical carbon dioxide to remove residual solvent, unreacted monomers and byproducts of the heated reactions or curing of the film (see especially column 5, lines 40-51, column 7, lines 1-15 and 44-48 and column 8, lines 8-23).

It would have been obvious to one of ordinary skill in the art to have modified the Shaffer et al process, by contacting the cured and coated semiconductor device with supercritical carbon dioxide, to remove unreacted monomer, solvent and reaction or curing stage by-producs , as taught or suggested by Van Cleempt et al and McCullough et al, to result in precision surfaces that are free of defects.

Regarding claims 3-7, polymeric films containing layers comprising polyarylene resin, which include formulations obtained by precursors including biscyclopentadienone are also taught by Shaffer et al at paragraphs 25-27.

Regarding claims 9-12, polymeric films comprising layers of polysilsesquioxane are also taught by Shaffer et al at paragraphs starting with paragraph 32 and 63.

For claim 13, the film is applied at multiple, intra or inter-levels or layers in Shaffer et al (see figures, Abstract, etc.).

Claims 1,3-7, 9-13 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over McCullough et al patent 5,908,510 in view of Shaffer et al PGPUBS US2002/0052125 and Van Cleemput et al patent 6,576,345. McCullough et al disclose forming of a semiconductor substrate or wafer (column 1, lines 33-43), disposing a low dielectric constant curable polymeric film, such as polyimide or other polymer, on the electrically conductive surface (column 1, lines 33-43 combined with column 5, lines 43-55) and then cleaning the film surface by contacting the surface with supercritical carbon dioxide to remove residues and impurities (text beginning at column 5, lines 57-62). ***McCullough et al teach to remove residue from surfaces, especially top surfaces (column 1, lines 18-19 and column 2, lines 50-54);, such surfaces suggested as being "pre-processed" (column 2, lines 50-54).***

The claims differ in requiring the film to be cured. However, ***McCullough additionally teaches*** the contacting generally being at a significantly elevated heating temperature that may be in a range and of a duration to effect curing of the substrate and film (column 6, lines 1-14 of McCullough and see Shaffer at Paragraph 65). McCullough also ***suggest that the film surfaces may be pre-processed (column 2, lines 50-54) while*** Shaffer et al teach curing of the polymeric film on the semiconductor substrate at paragraphs 65-68. ***Shaffer mentions in pargagraph 23 that polyimides may be used as a low dielectric filming polymer. Shaffer also describes in paragraphs 94-103 that the low dielectric polymeric material which is deposited onto a substrate constitutes a patterned organic film.***

It would have been obvious to one of ordinary skill in the art to have augmented the method of McCullough et al by adding the step of curing the polymeric material, as taught by Shaffer, in order to permanently adhere the film to the substrate, and prepare the device for etching.

The claims also all differ in requiring the semiconductor device and applied film to be contacted with supercritical carbon dioxide effective to remove residual solvents, unreacted monomers and byproducts of curing. ***Van Cleempt et al teach to heat and react monomers of a low dielectric, thin film polymeric film and apply the film to a semiconductor substrate device followed by contacting the film and substrate with supercritical carbon dioxide to remove residual solvent, unreacted monomers and byproducts of the heated reactions or curing of the film (see especially column 5, lines 40-51, column 7, lines 1-15 and 44-48 and column 8, lines 8-23).***

It would have also been obvious to one of ordinary skill in the art to have modified the McCullough et al process, by contacting the cured and coated semiconductor device with supercritical carbon dioxide, to remove unreacted monomer, solvent and reaction or curing stage by-producs , as taught or suggested by Van Cleempt et al, to result in precision surfaces that are free of defects.

Claims 1 and 18, as now amended, and claims respectively dependent therefrom also differ from MuCullough et al in requiring the film surface to be comprised of polyarylene or biscyclopentadienone, respectively. However, Shaffer et al teach that films of semiconductor substrates or other materials may be of such organic materials

(paragraphs 25-27 and 32 taken with 63, respectively). It would have been further obvious to the skilled artisan to have utilized the particular materials taught by Shaffer in the production of cured film surfaces, because of the favorable dielectric and semiconducting properties and dielectric constants of the materials in producing multi-chip modules.

Regarding claims 3-7, polymeric films containing layers comprising polyarylene resin, including formulations obtained by precursors including biscyclopentadienone are also taught by Shaffer et al at paragraphs 25-27.

Regarding claims 9-12, polymeric films comprising layers of polysilsesquioxane are also taught by Shaffer et al at paragraphs starting with paragraph 32 and 63.

For claim 13, the film is applied at multiple, intra or inter-levels or layers in Shaffer et al (see figures, Abstract, etc.).

Claims 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shaffer et al in view of Van Cleemput et al and McCullough et al as applied to claims 1 and 18 above, and further in view of Jur et al patent 6,558,475.

Alternatively, Claims 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over McCullough et al in view of Shaffer et al as applied to claims 1 and 18 above and further in view of Jur et al.

Claims 14-17 further differ in requiring the contacting of the supercritical carbon dioxide to be accompanied with at least one solvent (or co-solvent). Jur et al teach, in a method explicitly aimed at improving on the method of the applied McCullough reference (column 2, lines 48-53), to clean semiconductor device surfaces with

supercritical carbon dioxide accompanied by co-solvents (especially column 5, lines 22-52). It would have been further obvious to one of ordinary skill in the art at the time of the invention to have added co-solvents to the supercritical carbon dioxide in the McCullough/Shaffer et al process, as taught by Jur et al, since carbon dioxide alone cannot remove all types of contaminants present and a greater portion of the contaminants can be removed by combination of carbon dioxide and co-solvent.

For claim 15, the solvents employed by Jur et al include alcohols and ketones (column 5, lines 47-51). For claims 16 and 17, although Jur is silent as to exact portion of solvent, he states that "measured amounts of solvent are added to the carbon dioxide" at column 7, lines 54-60.

Applicant's arguments filed on March 2, 2007, with respect to rejection of claims 1,3-7 and 9-18 have been fully considered but they are not persuasive.

It is argued that McCullough is far removed from teaching of contacting a low dielectric constant cured film surface with supercritical carbon dioxide to remove impurities therefrom, McCullough in large part, being directed to removing impurities from etched substrates not having low-dielectric films, or being directed to removing impurities from within the pores of semiconductor substrates.

However, it is again emphasized that the semiconductor devices cleaned by supercritical carbon dioxide, in McCullough, may include patterned film structures comprised of low dielectric polymer such as polyimide (column 5, lines 43-55). Shaffer mentions in pargagraph 23 that polyimides may be used as the low dielectric filming polymer. The only detail lacking in McCullough is

teaching of the polymer being cured. However, curing of polymeric films on substrates is well known in semiconductor device processing and details of curing are taught in detail in Shaffer. McCullough does suggest that the film surfaces may have been "pre-processed" suggesting process steps such as curing.

It is avered that McCullough is directed to removal of impurities from the surfaces, pores and via's of an etched surface instead of from surfaces of a cured film. However, it is submitted that the reference explicitly discloses removal of impurities from surfaces, including top surfaces of semiconductor substrates, and of removal of impurities from surfaces of polymeric films of such substrates,

With respect to rejection of the claims based on McCullough as a primary reference, it is generally asserted that "snippets" of the reference were pieced together, rather than considering the reference as a whole. It is submitted that a prior art patent or other publication is germane for all that it contains. The substantial portions of the McCullough reference not concerned with removing impurities from patterned film structures, do nothing to teach away from the claimed invention; they merely constitute a number of embodiments which are not relevant.

It is also argued that McCullough is directed to removing residue material from precision surfaces, which have been subjected to etching processes, whereas there is no requirement of the claims for a semiconductor device undergoing an etching process. It is submitted that the claims contain no language precluding the step of etching. In fact, Shaffer at paragraph 17 also concerns etching, in that it discloses that

etching may occur either prior to, or following, the formation of a low dielectric constant polymeric layer on a substrate, further demonstrating the pertinence of McCullough to combining with Shaffer.

It is argued, that even if a prima facie case of obviousness is correctly present, Applicant's show unexpected results in the discussion of Examples 1-3 and the Comparative Examples on Pages 14-17 of the Specification and associated Figure concerning removal of volatile aromatics with the supercritical carbon dioxide.

It is firstly asserted that the Figure actually shows only modest or moderate differences between surfaces having the carbon dioxide treatment and not having such treatment. The differences of treated and untreated surfaces in mean refractive index appear to range between 0.0005 and 0.001 unit in the instant Figure.

It is secondly asserted that the showings of unexpected results are not commensurate with the specific language or scope of the instant claims. The claims do not recite that impurities removed specifically concern aromatic byproducts formed as a result of the curing process.

Various arguments directed towards whether the formerly applied prior art teaches removal of residual solvents, unreacted monomers and curing by-products are rendered moot by the supplemental teachings of Van Cleemput et al.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph Drodge at telephone number 571-272-1140. The examiner can normally be reached on Monday-Friday from 8:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steve Griffin, can reached at 571-272-1189. The fax phone number for the examining group where this application is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either private PAIR or Public PAIR, and through Private PAIR only for unpublished applications. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have any questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JWD

JOSEPH DRODGE
PRIMARY EXAMINER

April 18, 2007